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EARTH RELATIONSHIPS

BY

WILLIAM JAMES SUTHERLAND

A Thesis Submitted for the Degree of

MASTER OF ARTS

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A STUDY OF EARTH RELATIONSHIPS.

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4. Soil and Rock Controls.
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* * *

GEOGRAPHY, A STUDY OF CONTROLS AND RESPONSES.

The "old geography" gave little intimation of the relationship that exists between controls and responses. Arbitrary facts characterized its teaching. There was little suggestion that the modifications and distribution of life, and the industries and characteristics of peoples were responses to the guidance of environmental forces, or geographic influence. Such a view of geography robs it of its richness and reduces the subject from a science to the mere data of relationship. Life is everywhere conditioned by environment. "Historic events, business transactions, and industrial operations each have place relations and are subject to conditions embodied in their physical surroundings. This precludes no other element in the setting of the event, for there are time relations, legal relations, and several other classes of non-material environmental elements, which in the present discussion are simply waived the more clearly to see the physical stratum."

Man can modify his environment, physical and social, but he cannot re-create it. So if reservoirs or streams are convenient, he can irrigate arid lands; if old water waves are discovered, canals are quite feasible; if a river current is too weak to carry its load and so obstructs commerce, jetties are practicable. In the most successful endeavor, men must consider well both the favorable and unfavorable of their environment, and finally choose the line of least resistance. Nature must favor his undertaking. A definition of the terms "control" and "response" may be helpful to those less familiar with the subject.

1. A Control is an element of environment that exerts a marked influence upon the development of a life form. It may prohibit, favor, or determine the particular trend of life.

2. A Response is a characteristic of a life form, effected through its yielding to the continued influence of a control or set of controls.

In order that beginners may secure somewhat

of the significance of this topic and because those who are interested may be inconveniently situated with reference to libraries, a short discussion will be given under the following heads:

1 - Temperature Controls.
2.- Moisture Controls.
3 - Soil and Rock Controls.
4 - Atmospheric Controls.
5 - Organic Controls.
6 - Topographic and Barrier Controls.
7 - Human or Psychic Controls.

1 - The distribution of plant life and to considerable extent its form, are dependent upon temperature. If the temperature falls below the freezing point for much of the year, plant life is prohibited and since animals are largely dependent upon plants for their habitat and food supply, terrestial animal life disappears. The extreme tundra regions offer examples of this kind. Life in arctic regions is largely aquatic since liquid water cannot maintain a

temperature below 32° Fahr., therefore a medium in which life may exist.

According to temperature and the responses which follow, land masses naturally break up into climatic and life provinces, well treated by Prof. I. C. Russell.[1] That temperature is very important as a control over distribution of life is attested by Dr. Merriam in the following words: "It is now pretty generally conceded that temperature and humidity are the chief factors governing the distribution of life, and that temperature is more patent than humidity."[2]

The Physical condition and character of peoples are to considerable degree responses to temperature. The monotonous cold of the Arctic, and the blazing heat of equatorial regions, have deadening effects upon the inhabitants. Stature and complexion are changed and mental and moral qualities caused to deteriorate. In temperate regions, where there are sudden changes in

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[1] North America, I. C. Russell, Chaps. III, IV, V.
[2] Geographic Distribution of Life in North America, C. Hart Merriam, Smithsonian Report, 1891.

temperature and several seasons, man is stimulated in many ways and here we find the highest degree of development. Further reference to the influence of climate is made in the Chapter on "Geography and Life."

2 - The best portions of our country have an annual rainfall of 30 to 40 in. such regions being well suited, so far as moisture is concerned, to agriculture. Farm crops cannot be produced successfully where the annual rainfall is much below 20 in., though the introduction of "dry farming" is overcoming to some extent the lack of moisture. Where the annual rainfall is below 10 in. the country becomes nearly barren, bunch grass and sage brush being common forms of the sparse vegetation. In regions of generous rainfall, forests abound. In Washington, where the annual precipitation is from 60 to 100 in., stand the majestic fir forests. Forests gradually disappear on approaching arid lands or deserts. In cold or arid regions, nature conserves the limited amount of moisture by decreasing the evaporation area of foliage. Hence the "needles" of conifers

is a moisture adaptation, as is the total disappearance of leaves in certain desert species. Again the roots of some desert plants attain a length equal to five times the height, so eager are they to secure moisture.

Special responses are seen in animals also. Schirmer has pointed out that the camel's hump is a reserve from which nourishment is supplied during long privation from hunger.

Nomadic habits of oriental people is a response to environment, chiefly to the arid conditions. Such people are compelled to go from place to place in order to secure pasturage and water for their herds, and hence they are alert, enduring,and often intelligent.

3 - The quality of the soil, in conjunction with temperature and moisture, determine the distribution and character of plant life. Limestone and phosphate rocks yield the richest soils. The cotton industry of the Inner Lowlands of Alabama is a response to its excellent soils from decomposing beds of limestone, while the soils of the barren Cuesta or "Chunnenugga," are from

resistant sandstone, and as a control, are negative. Population avoids this uninviting belt. Similar to the "cotton belt" is the Blue Grass region of Kentucky, with its meadows, pastures and high-bred stock.

Soil responses, either positive or negative, can be seen anywhere. Wheat responds admirably to the lacustral soils of old Lake Agassiz; "corn is king" in the drift soils of the Prairie Plains; and long leaf tobacco is the leading crop in the Red Sandstone Valley of the Connecticut River.

Rock is a term that may be applied to all inorganic materials and is referred to here because mineral resources of many kinds are controls of industries, growth of cities, construction of roads, immigration, and are often subjects of national discussion and legislative contention.

4 - Were the atmosphere static it would hardly deserve mention as a control, except from the standpoint of its component gases. But the atmosphere is always moving, the winds sometimes attaining a

great velocity and frequently shifting in direction, causing extreme changes in temperature and rainfall. Winds in themselves constitute important controls. Vegetation is often severely whipped and sometimes torn from its moorings by gales and hurricanes. It is readily observed in our northern states that trees, exposed to the winds, lean to the east, and that the longer branches point in the prevailing windward direction. In dry areas strong winds drive sand and dust before them often covering vegetation. Forests are buried in encroaching sand dunes, as in Dune Park, Indiana. Sea water is sometimes driven inland by unusual winds causing death and destruction. The tidal wave catastrophy at Galveston, Texas, illustrates the power of the wind in causing the sea to invade low coastal plains. Soils are sometimes completely removed from bed rock by wind action, thereby making life impossible.

5 - Not only do the inorganic features and the forces which play upon them condition and determine life, but often life forms react constructively or destructively

upon the organic world itself. It may often be that in this sense a Response becomes, in turn, a Control. There is a constant warfare in the realms of plant and animal life. "Though a summer field"- says John Fiske -"seems at first to be a scene of unalloyed happiness, one has only to delve a little deeper to find it a scene of robbery utterly shameless and murder utterly cruel." Again since animals feed largely upon plants, the plant world has much to do in determining the distribution of animals. The abundance of fish off the coast of New England is due to the ample food supply - crustacians and mollusks - which in turn thrive upon the lower forms of life swept in by the Gulf Stream and Labrador Current. The abandonment of the wheat industry in some of the western states has done much to exterminate the chinch bug. And so examples could be multiplied.

6 - Under the head of Topographic and Barrier Controls may be classed relief features of all kinds - plateaus, mountains, valleys, plains, deserts, gorges, canons, escarpments, water-falls and water bodies. Some

of the features here enumerated, as for example the plateau, offer no new consideration. The greater altitude causes a fall in temperature, which in turn precipitates the moisture on its more gentle elevations or at the escarpment which forms its margin. Hence elevation here resolves itself into a temperature and a moisture control. It may be also that a third component appears, viz., an atmospheric control, since the added elevation may permit winds to sweep the region with great carrying and destructive force. These new conditions, usually brought about by an uplift of a portion of the lithosphere, may have wrought a complete transformation from a salubrious and fruitful valley or low plain to a cool, dry, and wind-swept plateau, for which Tibet will serve as an example. For centuries its dry cold surface has been swept by the prevailing westerlies until it has yielded, in the form of fine dust, the famous loess soils found in the lower valleys of China. Barriers in the form of inaccessible mountain ranges and large bodies of water are effective

controls over distribution of life. Wallace has shown that not only do natural barriers have much to do with the distribution of life but that the origin of new species in general, result from changes in geographical environment.[1]

7 - Human or Psychic Control. No special case need be made of psychic control since man responds to organic environment and acts also as a control over it in exactly the same manner as other forms of life. It is a matter more of degree and of perfection than of principle. The ability to reason gives man added advantages in his struggle for existence and supremacy. In pioneer days men sailed up streams until falls were reached; here portages were necessary, camps were formed, which in time became cities. But man discovered that the swiftly flowing water offered advantages in water power, so in time mills were built. The great flour mills of Minneapolis are

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1. Island Life, and Studies Scientific and Social, Vol. I, Wallace.

located at St. Anthony's Falls, conveniently near the wheat fields of the west and at a focal point of great commercial lines to the south and east. But even here man is responding rather than controlling, though the psychic element must be considered.

Man often, however, modifies his inorganic environment in a way and to an end that might never be wrought by natural forces or physiographic processes. Instances of this kind are often seen in the construction of roads and water ways, well illustrated by the Panama project, and the drainage Canal of Chicago. But in such cases man is guided and controlled by nature to a large degree. Had not an old water way been discovered, in the latter case, showing that Lake Michigan once really did discharge its waters southward into the Illinois River, man probably never would have undertaken the great engineering feat of constructing a drainage canal. Scholars have shown that not only physical attributes of all life are responses to organic and inorganic environment, but further that the social institutions of

civilized races are determined, very largely, in the same manner.

In its best sense geography is a study of controls and responses. It is a study of life - man included - as related to environment. Physiographic features and forces constitute the major controls, with organic controls as minors. The responses are found in the organic world, Says Prof. Davis: "In its present modern phase, geography is essentially concerned with the rational correlation of the items that fall under its two parts: on the one hand, the items of inorganic conditions that constitute the physical environment of living forms; on the other hand, the items of organic response made by living forms to their environment."

The richest and most significant phase of geography, then, must terminate in this relationship, and teachers of the subject must comprehend the importance of treating the subject scientifically.

* * *

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REGIONAL GEOGRAPHY.

The selection of material and its elaboration are two very important questions which confront every teacher of geoegraphy. In the matter of selection that which is fundamental should guide. There is such an unlimited amount of geographical material that, unless the teacher deals with general principles, he is in danger of being lost in the maze of detail and item. The notion that one must know all of the individual facts relating to location is not the true test of geographical knowledge. Geographical information, must in the end, be systematized - thrown into general catagories and linked together by some general principle which shall be the basis of organization. If the student understands the principle and can give concrete illustrations, his knowledge of geography may be quite comprehensive, even though there may be very many items and facts quite interesting in themselves, of which he is entirely ignorant. In selecting topics

for study the teacher must be sure that they are characteristic, far-reaching and typical. Whatever he emphasizes should be applicable to some other topic. A mere fact which cannot be used to explain or give significance to some other fact or serve as a datum of induction, is only a burden to the mind. In geography as in mathematics, the principle is the all-important thing. These principles will appear again and again in the study of different topics in different regions. When the pupil has mastered the principle, the mere recognition of it will suffice in the new topic. One great difficulty which has confronted the student in the past is the vast number of topics which seems to demand treatment. Our best scholars have come to recognize the physiographic region as the best unit for study. Such a region is homogeneous in structure and physiographic controls. It offers the advantage also, of being, in most cases, a larger unit than one inclosed by political boundaries. A physiographic region may include several or many political units, and instead

of making a study of the controls of each separate political unit and associating these controls in each case with the political unit, the study of structure, surface, soil, temperature, and winds may be worked out once for all and applied to the whole region. Much economy would result from a more general recognition of this unit in the study of geography. Our newest and best books study countries by regions, and the advantage which come to teacher and student alike, by use of an areal unit in simplifying geographical information, is great. The study of the United States for instance, might be centered about eight or ten regional studies and by this means much more time be given to elaboration than would otherwise be possible. Facts for their own sake cannot always be justified. Elaboration is useful and essential in tying together and relating the various factors which have had to do in making the earth and its people what they are. When the teacher or student has discovered these factors and has traced each one of them carefully to see how it has

influenced earth or man, and has discovered, also, how it has worked with or against other forces either natural or human, has he carried elaboration as far as it is profitable. Principles are not a burden to the mind, but are helpful in explaining observed phenomena, and are a source of power and of pleasure to the student. Elaborations, if properly made, bring out the principle and give it a distinct central setting. Details may cluster about this center and be valuable as illustrations, but any one is not indispensable. Indeed there are so many facts that it is quite impossible for the student to know all, and frequently there is but little choice from the standpoint of utility which one of several the student should learn. The selection of the larger unit of study avoids needless repetition, assists in better organization of material, enables a more complete elaboration, and permits of a more scientific treatment, since a regional study brings the physiographic and outographic factors into the most systematic relationships. Prof. R. E. Dodge, in speaking of

geography for secondary schools,[1] uses these words:

"The regional geography of the future will be a course taught scientifically and causally and will include a special consideration of the commercial geography of areas and nations. Thus the essential elements of physical geography will be taught as a basis for studying the man and life side of the subject and physical geography will by no means be entirely overthrown. The point of view will be different from the point of view in reference to that subject held at present. Physical geography will not be taught as an end in itself but as a means to an end. Selected parts of the whole field will be studied as fully as needs warrant and as scientifically as now, but always in order that the application of the selected facts and principles may be given in a careful study of the larger geography of given areas and regions. This study will involve the use of texts, maps and atlases, will be strong in laboratory work, will include the

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1. Educational Bi - Monthly, June 1909.

elements of political and commercial geography, and will be well knit into a united whole. Such a course, or one on closely similar lines, will have all the strength of the present work in physical geography, but will be more valuable as a part of a secondary course than any specialized phase of the subject of geography can be. Regional geography for secondary schools will not be a thing of "shreds and patches", it will not be feebly related facts and semi-useful statistics, easy to learn and equally easy to forget. It will be a disciplinary subject of great worth in the education of any person of secondary age." And is not this equally true of the regional treatments in the seventh and eighth grades?

The argument for a regional treatment in the higher grades, as seen by the author, are these:

1. The units are larger and "scrappiness" is avoided.

2. There is economy of time. Often the geographic facts relating to a small political unit,

are equally true of a large physiographic region.

3. The treatment is more scientific, the two great phases of geography being ideally correlated.

4. Because of the above, the organization is close and strong, the organizing principles being the causal or rational idea or element . (See Chapter on "The Rational Element as an Organizing Principle in Geography.")

The Physiographic Region is the natural and logical unit for study.

* * *

AN ILLUSTRATION.

THE GULF COASTAL PLAINS

The gulf plains are the western expension of the Atlantic coastal plains. They include a large area of land fringing the Gulf of Mexico, and are bounded by a line which forms a divide in Florida, and then extends north and west through Macon, Georgia, passing just north of Montgomery, a little south of Birmingham, just cutting the northeast corner of Mississippi, following the Tennessee River north to the Ohio, thence west to Ozarks, southwest through Little Rock, crossing Red River at the southeast corner of Oklahoma and passing through Dallas, San Antonio and Austin to the Rio Grande. This irregular semicircle from Florida Bay to the Rio Grande by the way of Cairo, Illinois, includes the Gulf Coastal Plains.

I. History and Topography.

The gulf plains occupy a part of the great central depression of North America, which, during the Paleozoic

Era, was submerged by a great inland sea. Before this subsidence, there is great reason for believing that the Appalachian Mountains extended across Mississippi and Louisiana, into Texas. At the close of the Jurassic Period, a great orographic change lowered the gulf plains and admitted the sea to southern Illinois. Consequently, the Silurian, Cambrian and Pre-Cambrian formations of Alabama plunge beneath the Cretaceous to the south and, in regions northwest of Austin, Texas, are known to dip eastward, and are in the same order. In each case the Carboniferous lies to the north, showing the drainage to have been in that direction before the subsidence. The drainage of Texas, Louisiana and Arkansas is now against the dip of the rocks, a condition which would result from a lowering of the Mississippi River valley. The overlying rocks, also, are thicker near the central portion where the depression was greatest.

The Gulf Plains are the uplofted bed of a former sea, lifted without disturbance. The highest portions are along the northern borders where the altitude reaches

1,000 feet, and from which it slopes gently toward the present shore, much of the margin being but little above sea level.

The Gulf Plain in Florida slopes gently toward the gulf. Florida is a young region, lifted from the ocean floor by the continental force that is supposed to have lifted the Rocky Mountains from the Pacific Ocean. The surface of Florida is broken by a ridge, known as the "Trail Ridge," which extends from the northern border of the Everglades, and, in places, reaches a height of 230 feet. Much of the state is but little above sea-level. It being so low, the drainage is imperfect, the number of swamps and lakes being large. The solution of limestone often gives rise to lakes, ponds, and sink holes.

Probably the most interesting topographic feature in the coastal plains of Alabama is the Cuesta. It is a ridge of resistant rock which borders the cretaceous lowlands on the north, and reaches an altitude of 250 feet above the adjacent surface. In eastern Alabama

it is a watershed between the Alabama River on the north, and the Chattahoochee and the Gulf on the east and south. This ridge, known also as the Chunnenugga, is made of (1) hard limestone ledges, alternating with beds of indurated, silicious sandstone, becoming almost a quartzite, and of (2) the buhrstone formation. The country is rugged and hilly, and the soils sandy and very poor. The hard rocks which underlie the ridge have resisted the action of the weather, while the soft cretaceous formation to the north has suffered great erosion and its surface has been lowered by differential weathering from 100 to 200 feet below the summits of the ridge. To the north the slope of the Cuesta is steep and often precipitous, while to the south it is much more gentle.

During the Juratrias Period, southern Alabama was higher than at present, as is shown by the fact that none of its formations have been exposed. After Jurassic time a subsidence permitted an encroachment of the gulf until the shore lay as far north as the present northern

boundary of the Gulf Plains. Erosion from the old lands brought materials into the gulf, the coarser being deposited near the shore in the strip of the coarse sands and gravels, separating the Paleozoic from the Mesozoic formations, while the finer silts went into the deeper water and were incorporated in the Cretaceous and Tertiary strata. At the same time the land was rising, the shore line moving southwest, and exposing newer and newer beds lying in parallel belts in an east-west direction across the state.

The topography of Mississippi and Louisiana offers no striking feature. The meanders of the Mississippi River have left bluffs of loess and loam, often 100 feet high, overlooking the valley. Even though Louisiana is very low, portions are well dissected. The "Bayou Sara Quadrangle" shows elevations ranging from 20 to 320 feet above the sea. The region is characterized by steep slopes to creeks, and by a broken surface. North of Natchitoches in Louisiana are found Cretaceous outcrops. Other Cretaceous outcrops, known

as the Five Islands, are in the southern part of the state, are too small to be features in topography. The region through which the Red River passes abounds in small lakes and bayous. Many of these are caused by the Red River raft damming the mouths of tributary streams until their basins are converted into elongated lakes.

The surface of the Texas Coast Prairie[1] is low, the altitude of the inner border not exceeding 100 feet. The belt is broken only by drainage grooves which are fewer and fainter as the Rio Grande Gulf is approached. The drainage system is young. The country west of the Coastal Plains increases in altitude and has an older and better developed drainage system. Undulations and low, rolling hills appear as the Balcones Escarpment is approached. Some of the hills are capped with gravel brought by erosion from Edwards Plateau to the west.

The Timber Belt is a rolling country, 200 to

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[1] Divisions of the Texas Coastal Plains are defined in the discussion on "Surface Rocks and Soils."

600 feet high, with occasional hills reaching 700 feet. These hills are wholly the work of the erosion, there being no distortion of the earth's crust. Some of the highest points are capped with sandstone containing considerable iron. They are often called mountains. Mt. Salem and Gent Mountain in Cherokee County are examples. Occasionally the hills are broad,assuming the form of plateaus or broad mesas. In general, the Timber Belt is a beautiful upland country, well suited for the fruit industry in which it excels.

II. Surface Rocks and Soils.

The rocks of the gulf plains belong wholly to the Tertiary, Quaternary and Cretacous systems. These formations dip toward the gulf, the Quaternary overlapping the Tertiary which, in turn, overlaps the Cretaceous. Many of the deposits of the Mississippi Embayment never hardened, or at least never become resistant, and are easily weathered and eroded. In general, the rocks are sandstone, limestone, shales and lignites. The soil

offer great variety, being chiefly sands, clays, loams and alluviums, whose fertility ranges from unproductive sands to the richest of clays and loams.

The Mississippi Delta.- The great wedge-shaped area with its base southward and its apex extending northward to Illinois, constitutes the Mississippi Delta. The delta proper is three hundred miles long and has an area of twelve thousand three hundred square miles. The soils of the delta are deep, rich alluvium brought down by the Mississippi River and its great tributaries. Along the Mississippi, on either side, southward from the Ohio, terrestrial deposits are found, while farther back the fossils are marine in character. From borings exposing these deposits the extent of the delta has been determined. Much of the lower Mississippi is a grading and its overflows have deposited much material just outside of the banks, causing the land to slope gently away from the river. A cross-section of the river at Donaldsonville, Louisiana, illustrates this well. When floods occur

sufficiently high to overflow, great sheets of shallow water are imprisoned back of these natural levees, where they contribute their loads of waste to the building up of alluvial plains. A large part of Louisiana and Arkansas,and considerable of Mississippi, have been deeply covered with alluvial deposits. From Cairo, Illinois, the river swings back and forth in a flood plain which extends from 15 to 20 miles on either side of its channels. Oxbow lakes are common, and terraces of alluvium and bluffs of loess often overlook the valley.

The history of the Mississippi River development seems to include a long period of subsidence and deposition, a short period of elevation and erosion, and a second period of subsidence which is still going on. At the beginning of the first period of subsidence, the land in northern Louisiana stood 250 feet higher than the present altitude, and at the close of the movement was 100 feet lower than it is to-day. Sand and gravels were deposited in the upper part of the valley, and

fine silts in the lower part. During the period of elevation which followed this subsidence, the river cut out many deposits. The amount of excavation can now be judged by the height of the Port Hudson bluffs and the Opelousas. In the Red River valley the excavation was 60 feet. Now a second subsidence is going on,evidenced by the drowned condition of the mouths of many coastal rivers; by the burial of Indian mounds, as at Belle Isle; by the almost stationary condition of the mouth of the Mississippi; by the formation of the dune-shaped islands just off the coast; and by the investigations of Mayor Quinn, United States Engineer, who reported subsidence of one foot between 1875 and 1894. The river development shows in order: basal gravels, fluviatile Port Hudson or old alluvium, and yellow loam-loess. The Port Hudson consists of swamps and marine clays and sands which cober parts of Louisiana and Mississippi.

Loess and Loam .- The loess is a homogeneous, yellow, fine-grained, calcareous, silty and unstratified

loams. It is found in hills bordering the river channels. Loess is also found skirting the east bank of the Mississippi at Vicksburg, and bordering the bluffs of the Yazoo River to the north.

The loess and loam in the Mississippi are, essentially, flood-plain deposits of glacial debris. The melting of the Great Glacier, the southern margin of which corresponds roughly to the courses of the Ohio and Missouri rivers, furnished floods which carried the finer morainic materials southward into Mississippi and Louisiana. The loess is of great thickness which shows that it could not be a disintegration from the underlying rocks. Its vertical extent sometimes reach one thousand feet. It does not show stratification, a fact which distinguishes it from the "Orange Sands" on which it lies. The absence of lime distinguishes it from the bluff formation along the Mississippi River.

The loess is often deeper as rivers are approached, which shows that such channels were preexistent. Increased thickness is observed near the Mississippi,

Black and Tombigbee rivers. The erosion of loess surfaces now assist in the transfiguration of the country.

Loess and loam are continuous in the Mississippi, though the former is absent in the bluffs. They pass each other by insensible gradations. They are said to be homotexial and synchronous. The loess-loam was deposited while the region was at sea level and its position shows that no submergence have since occurred. As the great gulf into which the fine materials were deposited was not deep, the heavily loaded streams carried the fine sediments far outward. The later recession of water permitted winds to modify the position of the materials, hence both eolian and aqueous agencies have assisted in the formations. The yellow loam is unstratified as a result of sluggish, overloaded streams, or of consequent modifications. No old shore lines are visible in these formations. The yellow loam is the latest deposit in northern Mississippi, extending fifty miles east of the Yazoo bluffs, and is described

by Hilgard as the non-calcareous division of the loess. The loess proper is a fine calcareous clay, containing a great variety of land and fresh-water shells.

The alluvium along the Mississippi River, and so largely forming the delta, is rich but low and swampy, and abounds in lakes and bayous so that much of it is uncultivable.

The Mississippi delta is that of a low-grade stream. The materials are fine and unassorted. It is an alluvial cone, but the slope is too gentle to be detected with the eye. It is a compound formation, the secondary deltas often uniting in form lakes, as in the case of Pontchartrain. The depth of the delta is, approximately, 1,000 feet.

In southern Alabama and Mississippi, and in the region southwest of the great bend of the Red River in Louisiana, there is a broad belt of "Orange Sands" generally considered coastal deposits of the Pliocene Period. They are now known as the LaFayette formation. At the time of their deposition the coastal plains were sub-

merged, a southward tilting stimulating river action, a result of which was the transportation of great volumes of sand and pebbles into the shallow waters of the gulf.

The Lafayette series consists of a well-rounded, water-worn quartz grains and pebbles, iron-stained, and often cemented by the iron oxide into ferruginous sandstone. The soils of southern Mississippi, and especially of Alabama, having a consistency of 80 per cent. quartz sand deeply colored with iron (from which the name "Orange Sands" originated) and mixed with aluminous and clayey matter, forming a sandy loam of low fertility.

In Alabama a very interesting and clear illustration of belted coastal plain is found. The northern part of it is mountainous and belongs to the South Appalachians. This part of the state is older and abounds in iron, coal, limestone and marble. South of these "old lands" are the inner lowlands, a belt of rich, black, level soils about seventy-five miles in

width, extending from Georgia westward across Alabama, and northward through Mississippi, into Tennessee. These soils are of Cretaceous origin and are highly productive. Owing to their fertility, and the long, warm, growing season, the cotton industry has been localized in this region.

South of these Inner Lowlands is a wide ridge of resistant rocks and unproductive sands, the Cuesta. The formations of this Cuesta are of Eocene Age and constitute the Claiborne group, the two subdivisions being the Claiborne proper and the Buhrstone. The Claiborne beds constitute the upper group. They are loose, incoherent, calcareous and ferruginous sands and glauconitic clays. The sands abound in fossils. The Buhrstone affords a marked contrast, being composed of hard, coarse and often glauconitic sandstone; hard, yellowish, silicious sandstone resembling quartzite; and flinty limestone. Owing to the great resistance of the rocks, the country is broken and rugged. The high, cherty hills of Buhrstone are called mountains

in many localities. The soils are very poor, usually covered with long-leaf pine, the whole ridge being only sparsely settled. This belt offers a marked contrast to the Black Belt to the north, which is the great agricultural belt of Alabama.

In Texas the Coastal Plains include the Eastern and Southern Provinces. There are three well-defined types of country, the Coast Prairie, Timber Belt and Rio Grande embayment. These regions lie in belts parallel to the coast.

The Coast Prairie is a belt not over a hundred miles wide, bordering the gulf, in Texas and Louisiana. It is a structural plain, newly reclaimed from the gulf. Lagoons fring the coast, inside of which river sediments are collecting. The region is level, the interior margin not over 100 feet high. The surface is broken by deep grooves of streams constituting a young drainage system. The sea border is submerged and slopes gently. Along the Sabine River the Coast Prairie is fifty miles wide, but increases to one

hundred miles at the Brazos. The monotony is broken only by strips of timber which follow the streams. The larger part of the Coast Prairie is included in the southern province. The soil is sandy, clayey and alluvial. Between the Brazos and Nueces rivers the soils are clayey, while both the eastern and western parts are sandy. Fine yields of farm products prove their great fertility. Cotton, sugar and fruits are extensively grown.

West of a line from San Antonio to Laredo there is a low, synclinal trough threaded by the Rio Grande, known as the Rio Grande Embayment. The surface here slopes southeast, forming one side of the trough. In Texas the embayment consists of a low, broken plain butting against the Balcones Escarpment on the west. The Lafayette,or Fayette, Prairie occupies this region and stretches entirely across the state, having a width of from forty to one hundred miles. The soils are highly productive, their fertility being due to the lime which they contain. Usually they are of a black

clayey or sandy character. The richness of these soils, together with their favorable location to secure rainfall, makes the Fayette Prairie region a rival of the black, waxy soils of central Texas.

These plains near Spofford and Del Rio are of the nature of gravel-covered flats resembling the llano. They are covered with storm-washed materials. In Uvalde and Kenney counties are localities in which necks, and monadnocks capped with igneous rocks, abound.

The Timber-Belt beds are north and east of the Fayette Prairie. The country here is rolling, broken and heavily timbered. Its altitude above the gulf is from two hundred to six hundred feet. Some hills are one hundred feet higher, and are due to erosion. No disturbance is any where seen. The hills are capped with iron sandstone of great hardness. The soils here are red clays, red sands and green-sand marls. The marls contain glauconite, a valuable fertilizer, and fossil shells, which make it especially productive. Beds of lignite are common.

The Balcones Escarpment is a series of steep faults running northeast and southwest along the west margin of the Coastal Plains. Just east of the Balcones the plains are older, higher and more dissected, and are known as the Black Prairie. The highest points here are 750 feet. The Austin Quadrangle shows remnants of an old plateau, from 975 to 1,100 feet high, capped with limestone and forested with live and post oak.

Florida.- The entire state of Florida is underlaid with a soft, easily weathered limestone, often resembling chalk. This soluble material often gives rise to sink holes and lakes. St. John's River is a series of such lakes. The limestone nowhere shows disturbance, but is a solid, homogeneous mass. It is unstratified, and of Eocene Age. Resting upon it are scattered beds of phosphate rock, formed from the excrement of sea fowls. Rains have washed out the guano and soluble salts, leaving the unsoluble phosphate of lime, now of great commercial value. It is shipped in large quantities to Europe.

III. Rivers and Drainage.

The Red River has its source in the llano, and drains a vast area of which 29,000 square miles are in Texas. Its length is 1,500 miles. It is navigable to Shreveport. It derives its name from the red clay which colors its waters. The river in the llano traverses an alluvial flood plain, and, as in the lower Mississippi River, the greatest elevations are along the river banks, the plain sloping away toward the hills which border the valley.

One of the points of interest in the Red River is the great raft which once filled the lower course for great distances. This raft is an accumulation of trees thrown into the river in times of flood. They pack closely and gather leaves and silt and so form an obstruction which causes the river to overflow, and to find its way into the back country where it follows the base of the hills until it again finds its way into the main channel below. This process repeats many times as

the raft continues to grow. Since the timber along the river has been largely removed for agricultural purposes, the conditions for raft building are less favorable.

To the constructive work of the Red River and its bayou tributaries is due the presence of many lakes. These have been classified as: (1) cut-off lakes, (2) lakes of enclosure, (3) raft lakes, (4) delta lakes.

The extension of secondary deltas often meet and so enclose sheets of water, thus forming delta lakes. Pontchartrain is an example.

Raft lakes are the result of an extension of the raft up-stream until the mouth of some tributary is dammed by the accumulation, and the tributary valley flooded. The size of the newly formed lake will then be determined by the height to which the dam is built (the quiet reach of water favoring the deposition of silts to considerable height), and the volume of water which is drained into the raft-dammed basin. The volume of water is often largely increased by the formation,

above the dam, of an outlet bayou or distributary, brought about by the flooded condition of the main stream, and which conveys large volumes of water into the lake.

Lakes of enclosure are common and owe their existence to natural levees. As the river rebounds from a hill or bluff it often makes large loops which become like basins when the river has sufficiently built up its banks in the form of levees. The water is then confined between the bluff and the semicircular levee.

Cut-off lakes are common in the lower Red River valley, and are formed in the usual way, by a meandering stream that is aggrading its course.

The Brazos is one of the most important rivers in Texas. It drains 59,000 square miles and its length is 950 miles. It is navigable for light boats for 40 miles. East of the Brazos in Texas the rivers are clear and have swift currents, while west they are overloaded with silt and are sluggish.

The Trinity River enters Galveston Bay about forty

miles from the city of Galveston. This river is 550 miles long and drains an area equal to that of Vermont and Massachusetts. The Colorado is the same type of stream, but is 900 miles long and drains a larger area.

The Rio Grande rises in Colorado and is 1,800 miles long. It drains only a small area in Texas, its basin being less than fifteen miles wide. It is subject to overflow and often causes great destruction. Much of its water is drawn into irrigation ditches.

The rivers of Texas are not valuable for commerce as their mouths are unusually blocked with bars, and the volume of water which they carry fluctuates greatly.

The drainage system in Texas is well developed and lakes are rare. The numerous and extensive lagoons along the shore owe their existence to the building of barrier beaches.

The Alabama is the most important river in the state whose name it bears. It is formed by the confluence of the Coosa and Tallapoosa rivers, and cuts its way through the Cretaceous and Tertiary deposits,

features are those of a rising coast, though there is clear evidence of a slight submergence since the general uplift. Taking into consideration the shallows west of Florida, the delta formations of the Mississippi River, and the barrier beaches that frings Texas we should not expect many good harbors.

Considering the shore in detail, a broad fringe of shallows is noted, extending from Cape Sable to Cape Romano. The shore bordering these shallows is inaccessible to vessels, it being a tangle of swamps in which a salt vegetation encroaches upon the sea. There is no distinct demarcation of land and sea, islands being very numerous.

North of Cape Romano the coast is more characteristic. The streams end in enlargements formed by valley flooding due to a depression of the land. The most important flooded valleys are those of Hillsboro River, known as Charlotte Harbor, and Tampa Bay. Each of these embayments is fringed with mud banks. The west coast of Florida is destitute of coral formations as

the Gulf Stream does not bathe this shore, in consequence of which the water temperature is unfavorable to the coral polyp. Barrier beaches at both ends of the harbor mentioned above, concentrate the tidal currents and maintain water of considerable depth. By extending the piers, good harbors for large vessels are secured. The importance of Tampa harbor is great as it is adjacent to the most extensive phosphate beds in the world. These beds extend back from the harbor for a distance of forty miles.

North of Tampa Bay the water is shallow and no good natural harbor is found for 200 miles, when St. Joseph Bay is reached. Occasional artificial harbors are maintained, as at Cedar Keys. Between Tampa Bay and Cape San Blas the shore is in the form of a broad-mouthed bay, 200 miles in width and 70 miles deep. Wave-borne sediments have partially filled this embayment and converted it into a shoal water region, characteristic parts of which are St.George's Sound, just west of Apalachee Bay, which is surrounded by barriers.

Coastwise vessels only can enter this bay.

West of San Blas there is a deep-water area known as St. Joseph Bay. The water is from twenty-four to thirty-six feet deep, but so swampy that the harbor is of little use. It is noted as being the deepest harbor on the Atlantic coast, formed by land spit.

From San Blas to the Mississippi delta there is another broad embayment, not named. Reentrants formed by gentle subsidence, and partially closed by barriers, characterize the region. There are also four submerged valley harbors which admit large vessels. They are St. Andrews, Choctawhatchee, Pensacola and Mobile. The first two have shoal entrance, but the rivers which enter Penscola and Mobile Bays maintain deep passages through the enclosing barriers. Before the uplift Mobile Bay extended much farther north, but a delta has filled the bay head so that deep water is now found at the mouth only. The opening into this bay, once twenty miles, is now but little over two miles. Fifty miles east of Mobile is the cape of the Mississippi delta, having a front of 200 miles

and extending 75 miles into the gulf.

Just after the glacial epoch the amount of sediments was greater and the delta built rapidly. The only entrance to the Mississippi River is through its main tributaries on the southwest.

Westward from the mouth of the Mississippi are many reentrants of shoal water admitting only coasting vessels.

The first harbor of importance on the Texas coast is at Galveston, a distance west of 300 miles. The reentrant is flooded and barred from the sea by barriers. Shoal water two miles in width lies between the harbor and the sea, but government work keeps it open. This is the best harbor on the gulf coast. Behind the beaches the water is only nine feet in depth.

Along the shore southward to the Rio Grande reentrants occur, but they are all shoal and admit only coasting vessels. The coast line is an almost continuous line of beaches enclosing lagoons, often connected. A barrier 110 miles long extends from Santiago to Corpus

Christi, and is the longest barrier beach that faces any tidal sea. Many of the lagoons tend to assume a circular form owing to the action of winds, waves and eddies.

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GEOGRAPHIC INFLUENCES IN HISTORY.

A field of study, profitable and fascinating, is that of geographic influence in history. "The unity of the science of geography is in geographic influence, i.e., in the relation borne by the physical conditions to man, products, industries, and to the distribution of wealth, culture, and the various types of life."[1] Geography forms the basis of history and often determines its trend. Mountains and rivers direct the line of march of invading armies, and influence at least, the destiny of battles. Ocean currents and prevailing winds guide the courses of ships at sea. Mountain passes condition the settlement of distant plains. River valleys indicate the lines of least resistance for commercial highways. Industrial centers take advantage of falling water, and castle and fortress seek the eminence of hills.

Investigators in both history and geography

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1. Pamphlet: Geographic Influence, a Field for Investigation. Geo. D. Hubbard.

have made marked progress in tracing the relationships of geography and history. Numerous magazine articles have been written, and genuine contributions have been made by Prof. Albert Perry Brigham and Ellen C. Semple.[1]

The teacher of geography must pave the way for the teacher of history, by establishing a substantial geographic basis. The geography, too, must be made significant through the study of its influence on human affairs. The teacher in the grade or rural school who conducts the recitations in both of these subjects, has a fine opportunity to develop the relationship, now from the side of history and again from the side of geography. As a result of a wise correlation both of these subjects can be much enriched.

On both large and small scales the influence of geography is seen. The writer remembers how, in the district school, the pupils were taught to associate industries with cities. "Lynn was noted for the manufacture of ladies shoes"; "Bath, for ship-building";

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1. Brigham: Geographic Influences in American History.
Semple: American History and Its Geographic Conditions.

"Lowell and Lawrence for cotton manufacture", etc. No thought ever occurred to either teacher or pupils to discover why these industries were so distributed. The facts were purely empirical. The relationship that is now universally recognized between geography and history is one of significance, and is doing much to break down the old empirical method of instruction. So in their own communities, teachers would do well to discover as many cases of geographic influence as possible, and so to introduce in a concrete way, the companionship of history and geography.

With the many illustrations of those who have specialized in this field, it would seem sufficient simply to point the way to good books. One example by the writer may be permissable.

The Illinois river follows the old, partially drift-filled channel of the pre-glacial Illinois a stream of no mean proportions,being from one to two miles in width and carrying the overflow of the then enlarged Lake Michigan.

The Wisconsin Glacier in its retreat, partially filled with drift the broad deep channel of the preglacial Illinois and, as if intent on obliterating the mighty river, it dropped the Valparaiso moraine in the form of a half moon, skirting the south end of Lake Michigan. It thus defied the lake waters to again reach the Gulf by this route.

But the rains fell and the "run-off" of northern Illinois and Indiana carved post-glacial channels, steep-sloping and narrow, in the soft drift. Of this character are the Fox, Des Plaines and Kankakee Rivers which now feed the Illinois.

The present Illinois with its greatly decreased volume has been unable to remove the drift from its ancestor's channel, and the river today flows rather lazily swinging against the bluffs on one side and then on the other.

Streams are nature's highways of commerce, along which villages and cities are located and begin their careers, before the advent of railroad or canal.

So along the Illinois, towns and cities found their locations, sometimes on the bottoms and sometimes well up on the bluffs overlooking for miles the curves, bars, and islands in the river below.

On a site of the latter type, La Salle, Illinois, found its location.

But nature had done more to block out the industries which should employ the citizens of La Salle, long after the glaciers should have retreated, and the buffalo and Indian should have been exterminated or driven far to the westward.

So it happened that an upward fold, or anticlinal fracture as the geologist would say, was formed across northern Illinois, beginning in the neighborhood of Freeport and in a southeastward direction passing just east of the present site of La Salle, on into Indiana. This slow upward fold, did not disturb the Rock and Illinois Rivers which it crosses. They were abundantly able to corrade their channels deeper and deeper into the up-rising strata, thereby causing no

interruption of their currents, but in the end flanking their banks with vertical cliffs of white sandstone, of which Castle Rock and Starved Rock are historic examples.

This fold has served as a geographic condition or control and has had much to do with the industries of La Salle. It consisted of an upward bending or arching of deep seated strata, forming a broad ridge. But through the scouring of glaciers and the erosion of water the ridge or fold was planed off almost level with the surrounding country, the broken strata dipping both to the east and west of the axial line of the anticline. The disturbance brought to the surface the coal measures which were left exposed as outcrops and, in an early day, attracted "drift" miners to make settlements at and near La Salle. Also the uplift, which increased the vertical distance between bluff altitude and water-level in the river below, stimulated gradation and, as a result, deep gulches and ravines, in time communicated with the river, again exposing underlying

seams of coal.

Forced to the surface, also, was the St. Peter's sandstone forming the historic cliff -- Starved Rock. This sandstone is the raw material from which glass is made, and because (1) the coal was immediately at hand to melt the sand, and (2) because a great commercial city was developing to the northeast on Lake Michigan, men took advantage of the situation and La Salle became a center for the manufacturer of bottles. The glass industry extended also to Ottawa and Streator on the east slope of the anticline, practically repeating the conditions. (Le Conte thus defines an anticline: "An anticline is a line on either side of which the strata repeat one another dipping away from the axis.")

Underneath the strata of St. Peter's sandstone lies the calciferous Potsdam. It, too, was arched upward and exposed here where the Illinois river cuts the anticline. It is a notable fact, too, that this formation is not exposed elsewhere in Illinois.

From the calciferous Potsdam excellent portland

cement is made and to one who is in possession of this bit of geology it is perfectly clear why the Chicago Portland Cement Works are located in La Salle. Here the geographic conditions viz.,

1. Raw material, the Potsdam.
2. Abundance of Coal.
3. Nearness to a great market, Chicago.
4. Ample shipping facilities, railroads and canal,

seem to be very favorable to the industry. To this may be added the fact that a wanton destruction of forests has made substitute buliding materials necessary. The use of concrete is one way in which man has adjusted himself to the changed conditions. From the summit of Starved Rock a number of cement plants can be seen. Their existence is due to one of nature's freaks, and in an industrial way it illustrates geographic (geologic) influence on human affairs, or history.

By another of nature's accidents, the northwestern part of Illinois and the southwestern part of Wisconsin, escaped the scouring and planing of glaciers. Eroding and

denuding agencies, however, removed the later deposits and left exposed the Niagara limestone, Cincinnati shales and Galena limestone. Galena, or lead sulphide, is found in the crevices and pockets of this deposit. Even the early settlers on farms far to the south used to find profitable employment in winter by "drifting into" the pockets exposed in the gulches of this deeply sculptured region. Galena was named after its mineral, and "Platteville" is always associated with zinc. But there was no coal in this region to be used in reducing the ore, and following the law that it is cheaper to take crude ore to the coal fields than to transport coal to the ore, the valuable ores of the southern end of the Driftless Area in an early day found their way to La Salle where coal was plentiful and where communication by rail and water had been established with Chicago. Then, too, La Salle lay between the productive zinc fields of Joplin, Missouri, and Eastern Kansas. The coal fields soon attracted this ore and La Salle's zinc-smelting and manufacturing industries grew as a

result of geographic control. Nor was this all! The sulphur had to be removed from the zinc-sulphide, and this as a bi-product led to the establishment of large plants for the manufacture of commercial sulphuric acid. The industries of La Salle are directly attributable to this diastrophic movement of the earth's crust, which lifted the coal measures several hundred feet and exposed the early Silurian deposits, making mining easier and more profitable, and furnishing abundant material for the manufacture of glass and cement. The abundance of coal attracted the zinc ore and the smelting plants now in operation are among the largest in the United States. So important are natural resources that several railroads and a canal at an early date competed for its traffic.

But geographic influence does not stop with industrial history. Political history is largely shaped by resources and industries. La Salle's industries attracted foreigners of varied nationalities. The question of municipal government even in a small city

becomes an important social problem. There is, too, an esthetic side to the La Salle problem. The deep dissection of the uplifted region across from La Salle has produced perhaps the most picturesque scenery in Illinois. It is of such marked beauty that the last legislature of the state purchased the region and set it apart for a State Park. It abounds in hills, valleys, gulches, canons, waterfalls and caves, making Deer Park a rare region for the student of nature. But here again geographic influence is seen. The picturesque is a control over the economic. Railroads, trolleys, ferries, hotels and hacks are busy because an "anti-clinal fracture" and "sculptural gradation" gave La Salle this region of beauty.

The study of French exploration has firmly associated the heroic La Salle and his devoted Tonti with this region, though the busy little city that bears the name of the indomitable Frenchman, may be unknown to many. Even in savage times geographic conditions played their role in history. So Starved Rock, - the

inaccesible citadel, attracted the weakened Illini and here they perished from hunger or were mercilessly butchered by the Pottawottamies, in their effort to escape.

The story of La Salle could be repeated, with necessary variations, for many another city. What better example of genuine educational work, than that of teaching in the fulness of their relationships, local history and geography?

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GEOGRAPHY AND LIFE.

The leading consideration concerning all life is self perpetuation. The inalienable right to live is the most impressive thought revealed in nature. Dearness of life is the sole cause of the universal conflict in the organic world. A superficial glance at nature reflects the harmony and tranquility of a "daisied field in June", but a more careful scrutiny convinces us that the realm of nature is the scene of a warfare "utterly shameless and utterly cruel." "Long life and length of days" come only to the creature whose environment is favorable to its needs. Either organisms find desirable homes and congenial company, or vanish from the earth altogether. The security of life is contingent upon environment. The interesting adaptations of plants to secure sunlight, water, and food; and of animals to secure food, and for rivalry and defence, establish the fact that dependence characterizes every organism by determining its nature.

Animals derive food either directly or indirectly

from plants, for they alone possess the important function of organizing inorganic materials. Since the two kingdoms must occupy the same dominion, the struggle for existence is made more intense. But plants, in turn, are dependent upon proper conditions of temperature, moisture and soils. The temperature of any region leads to a consideration of the sun and its effect upon earth and atmosphere; moisture takes into account the aqueous envelope as affected by heat and winds; and soils result from the combined action of all these factors and forces upon the rock crust of the earth. Plants do not thrive in regions where the temperature remains long at or below 32°, as water is necessary to dissolve and transport nourishment. A meager precipitation of moisture, for a similar reason, stunts plant growth; but with sufficient moisture and a high temperature there is scarce a region in the world that would not "blossom as the rose".

A consideration of man's distribution and development reveals positive evidence of his response to physiographic conditions. Temperature and moisture

are chief among these, not only because they affect them directly, but because they determine the productiveness of habitable areas. The progress of civilization leads to the conclusions (1) that range and variation in climatic conditions are favorable to civilization and culture, and (2) that extreme and uniform conditions are unfavorable to the advancement of civilization.

Tropical regions support a luxuriant vegetation in response to high temperature, liberal rainfall and alluvial soils. The food supply is generous and were it not for other less favorable conditions a dense population might flourish. The range of temperature is scarcely more than ten degrees, and, in addition to the enervating influence upon human beings, it permits an uninterrupted plant growth, insuring abundant food with but little expense of human energy. The rank vetetation becomes a barrier which man declines to penetrate, partly because intertwining plants and vines obstruct his path, and partly because this tropical

verdure harbors a dreaded animal and insect life. Resistance to life, so far as food and shelter are concerned, is reduced to the minimum; the palm alone may furnish all that human life demands for mere subsistence. Excessive heat causes man to languish in the shade; excessive moisture breeds disease and makes cultivation difficult. The uniform climate and unlimited varieties in vegetation become monotonous and oppressive. Plant life holds the scepter! Man is over-awed with the fierceness and regularity of environing conditions. Long subjection has brought with it resignation and mental decadence. What wonder that the infantile mind should reverence forces so irrisistible as scorching suns, angry skies, gigantic trees and ferocious beats! What wonder that man should abandon a struggle for supremacy in which the odds are so against him!

Civilization is also in a low stage in the Arctic Regions. The Eskimo's struggle for existence is so intense that all human effort is expended in extorting from nature a meager support. If we reflect on the

conditions of his environment, we shall discover the most depressing monotony; the long silent night with only lurid gleams of light; the illimitable expanse of glacier ice; the absence of vegetation; the desolate climate; the few species of animal life; surely, his is a "universe of sky and snow." Here, again, nature outbalances man, and ambition is weighed down by conditions so monotonous, that no excitations appeal to him except those for food and shelter. Even the food that he eats so lacks variety that the building up of a sensitive and susceptible organism is impossible. He is as stolid as the world in which he dwells. Being driven for long periods to his home by the rigors of the clime, his emotional nature responds to enforced retirement and hence he manifests a strong love for home and family. Surely his is a case of arrested development; growth in intelligence demands at least some surplus energy after a mere livelihood is insured.

Temperature regions are characterized by a

great range of temperature and a varying supply of moisture. A rigorous climate demands well built homes and warm clothing; short summers demand great activity in order to mature crops; indigenous food-plants do not abound; soils produce only when carefully cultivated; woods are relatively scarce; metals are abundant but often difficult to obtain; and mountain barriers frequently separate productive areas. The variety of influences in environment demands versatile and symmetrical development. Even sudden weather-changes stimulate mind and body. Life becomes abundant only when it establishes many relations. Intellectual life is quickened in the consideration of that which is economical and advantageous. Rivalry and competition make life strenuous. Just as the equable temperature of the Tropics minimizes man's needs and leads to responses that are uniform, so the temperature realm multiplies the necessities of life and brings a variety of responses. The high temperature of summer, following a severe winter, is a powerful stimulant, and the reactions which lessen

the tension come in the form of linen clothing, electric fans, manufactured ice, open cars, railroads to mountain retreats and seaside resorts. So millions of men are busy because the sun has mounted higher in the heavens.

According to Herbert Spencer life is the process of establishing an equilibrium with environment. The more intricate and complex the equilibrial processes become, the higher the degree of life and the higher the scale of civilization. In low forms of life the adjustments to environment are simple, and the accomodations are largely effected by the organisms themselves. Every animal must respond to the demands for food and protection from enemies, or become extinct. The tropical inhabitant adjusts himself to his surroundings almost completely; he lives in caves or in the shelter of trees, wears little clothing and subsists on fruits, roots and insects. He is a direct response to an equable climate and a highly productive soil abounding with indigenous food-plants. Provision for the future is unnecessary

hence irresponsive and indolent habits are consequent reactions. Inactivity and stupidity are direct responses to conditions that make life easy. So nature, here violent and monotonous, outbalances a manhood that places little value upon an existence that is so generously bestowed.

Re-creation of environment is the test of enlightened civilization. In the lower stages of civilization, man stooped to adjust himself to nature and so became enslaved; but in highly civilized races, men have developed tastes and needs which nature, alone, cannot satisfy. So human ingenuity and discovery are summoned to transform material resources, and the work of nature is consummated with an artificial touch, which makes it serve more perfectly, a fastidious people. All arts and industries, all crafts and trades, have, in the end, a single function to perform; viz., the promotion of natural resources to greater usefulness. But all modifications of material resources demand an intellectual alertness which marks progress in

civilization.

It is interesting to trace out the history of localized industries, and one is soon convinced that favorable productive conditions coupled with advantageous means of distribution, are the determining factors. To one who has studied geography aright, it is unnecessary to explain why cranberries are grown on Cape Cod, tobacco in the Red Sandstone Valley of the Connecticut, rice in South Carolina, or wheat in Minnesota; or why locomotives are made in Philadelphia, plate glass in Pittsburg, furniture in Grand Rapids, cotton goods in Birmingham, or pottery in Trenton. Suffice it to say, that industries slowly but surely spring up in the regions well suited to their development. Frequently, where conditions are adverse, men triumph over nature's barriers to civilization, as when they tunnel mountains, connect oceans with watery threads, turn the course of rivers and moisten arid lands. Nature deals out her wealth with moderation in temperate zones and to them only who would "subdue and have dominion" over her. Life is dear because it has been purchased by incessant toil,

and it is versatile and abundant because in the struggle, it acquired knowledge, sympathy, judgment and mercy.

The trend of industrial history is determined by physiographic conditions. Man can modify his environment but he cannot annihilate it. In general, prosperity is coincident with a wise adjustment to geographic conditions. Chief among these are climate and soils of which much has been said. But land forms, themselves, exert important controls over industrial life. A general distribution of mountain ranges parallel to seas makes narrow coastal plains; close parallel ranges enclose inter-montane valleys; in the midst of the sea, volcanic disturbances project habitable lands; the subsidence of continental margins is responsible for numerous head lands and adjacent islands; and great rivers build and moisten far-reaching food plains. Hence it is that these earth processes fashion restricted habitable areas, while unrestricted areas result from the evaporation of large water bodies, or from the diastrophic tilting or lifting of extensive sea-floors. Broadly

speaking, habitable lands are restricted or unrestricted and a review of industrial life makes the following inductions possible: (1) Restricted habitable areas determine industries in which a maximum of labor is expended in the production of a minimum of material. (2) Conversely, unrestricted habitable areas determine industries in which a minimum of labor is expended in the production of a maximum of material.

The operation of this principle is reflected in the character of the people. The Norwegians, hemmed in between the mountains and the ocean, were long dependent upon the fishing industry, and years at sea developed them into the boldest and most famous of seamen.

When a yard of Belgian hand-made point lace is sold, ninety-five per cent. of the purchase price is for labor; the value of the raw material used is insignificant. In order that nearly five hundred people may live on a square mile, the highest possible utility must be given every production, by the expenditure of much labor upon little material. In Switzerland, where

metals and woods are scarce, hand made watches and ingeniously carved toys illustrate how a dearth of material may be transformed into great wealth through the application of much industry. Unusual skill, strict economy, and extreme perserverance are the characteristic responses in the people. Restricted tillable areas near Boston and New York stimulate truck-farming because an acre so employed furnishes a maximum of labor, the compensation for which comes when a limited quantity of choice seasonable vegetables finds a ready market.

Not only to industrial life does the principle relating to restricted areas apply, it extends also to political history with most decisive results. As England's tillable lands are much restricted, her own soils have long been unable to support her rapidly increasing population. In 1815 the Corn Law was passed to protect the English landlord. Under this obnoxious measure, the price of wheat in 1817 reached $3.25 a bushel, and the same year the weekly wage of a weaver was $1.02. The struggle for free trade soon followed. The exorbitant

price of wheat added to the misery of the under-fed laborer, and the tariff interfered with commerce. Manufacturers demanded free trade because they saw clearly that a more abundant food supply would increase the spirit and efficiency of the workmen, and would also tend to keep labor cheap. Had England's territory been sufficient to furnish food for her millions, the great political struggle that wrenched the very life of England, might have been averted. The misery, suffering, and abject poverty of the people enlisted the sympathy of noble hearts, who condemned a policy that caused "wealth to accumulate and men decay". Poets, reformers, and statesmen championed the cause of suffering humanity, and finally in 1846, Robert Peel through motives altruistic, or otherwise, deserted the Tories and introduced the bill which sealed the doom of the Corn Law and marked the beginning of free trade of England. So in America, geography is peculiarly interwoven with history. The coastal plains, with their rich soils and warm moist climate, must answer for the Civil War, says Prof. Davis,

for these conditions made slavery profitable. Ultimately, the economic resources of the South are responsible for the direful social and industrial situations of the present day.

In areas where the resources are unrestricted, the industrial problem is very different. In contrast to the Swiss, who makes a few ounces of metal into a watch worth ten dollars, or the Belgian, who converts a handful of flax into a yard of point-lace worth its weight in gold, the Pennsylvanian makes from his unrestricted resources, iron and coal, locomotives and steel rails. The problem of the Illinois farmer is the production of a maximum yield with the minimum investment of labor. A load of corn which brings $25, shows at least a return of $20 for material and the balance for labor. Dealing as he does, with produce in great bulk, he becomes wasteful and extravagant. If, instead of Illinois' eighty people to the square mile, it had Belgium's four hundred and ninety, no longer could "half a tillage stint" our prairie plains. No

half cultured farms, no weedy fence corners, no peaty swamps or alkaline tracts could exist. Agriculture in the past has been easy. Owing to its great possibilities, "man has had only to tickle the soil with the plow and it has laughed with a harvest." But in his greed to get bountiful returns, with little outlay of labor and capital, man is fast reaching a point of limiting returns. Because of reduced fertility, a point is reached at which a given outlay of labor and capital, fails to produce a proportionate yield. Here the study of geography touches life most directly! It is only through an understanding of soils, and a knowledge of the treatment by which their fertility can be maintained, that this point of limiting returns can be pushed farther into the future. So the agricultural college becomes a necessity, and the calling of the scientist is dignified by his reduction of "farming" to scientific agriculture.

Has too much been said concerning the influence of geography upon life, and too little concerning the value of the study of geography as presented in our

schools? The educational tendency is emphatically toward a training that touches life in practical, rational, and vital ways; hence the value of any study must be measured by its contribution to fulness of life. That man is best educated who best understands his environments, who most clearly recognizes his relationships and responsibilities to all other life, and who best uses their resources to promote the common weal. Every science deals with some phase of man's environment, and geography, which is a department of science, deals in a general way with the same subject-matter. Any study which aids in giving man the correct view of his place in nature is of great value either from the practical or the cultural point of view; for, indeed, culture to be worthy the name, must manifest itself in the every day life of a people.

The revelation of truth is one of the chief functions of all education. Superstition and tradition have ever blocked progress. Geography has assumed its share in the task of disseminating knowledge. A Genoese

visionary starting out to prove the rotundity of the earth, discovered a new world; Magellan consummated the unfinished task of circumnavigating the globe; the next great triumph of truth came in the middle of the sixteenth century, when Nicholas Copernicus bequeathed to science a solar system. With the contributions of Herschel, Laplace, Ritter, and Guyor, we might think the work of geography complete. But again comes the question more pointed and specific: "How can I, at the country cross-roads, influence life and character through Geography?" Seek the answer in this: shall men and women of the next generation be filled with "wisdom and understanding"; and shall they be free from the bondage of superstitions that distort and terrify life, then must the children of today be convinced that moons neither help nor hinder the growth of plants, nor affect the amount of rainfall; that soils, the chief source of man's wealth, are the repositories of plant-foods which unwise use may exhaust all too soon; that cyclones possess decided economic value since to them

and immutability of God's law. He may be convinced that retribution follows its transgression, in the physical as in the spiritual world, with unfailing certainty; and finally, that to him who is in harmony with nature, and therefore most likely to be "in tune with the Infinite", shall come "length of days, riches and honor."

* * *

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